

KidsCAVE

Developing an Immersive 3D
Learning Environment for Everyone

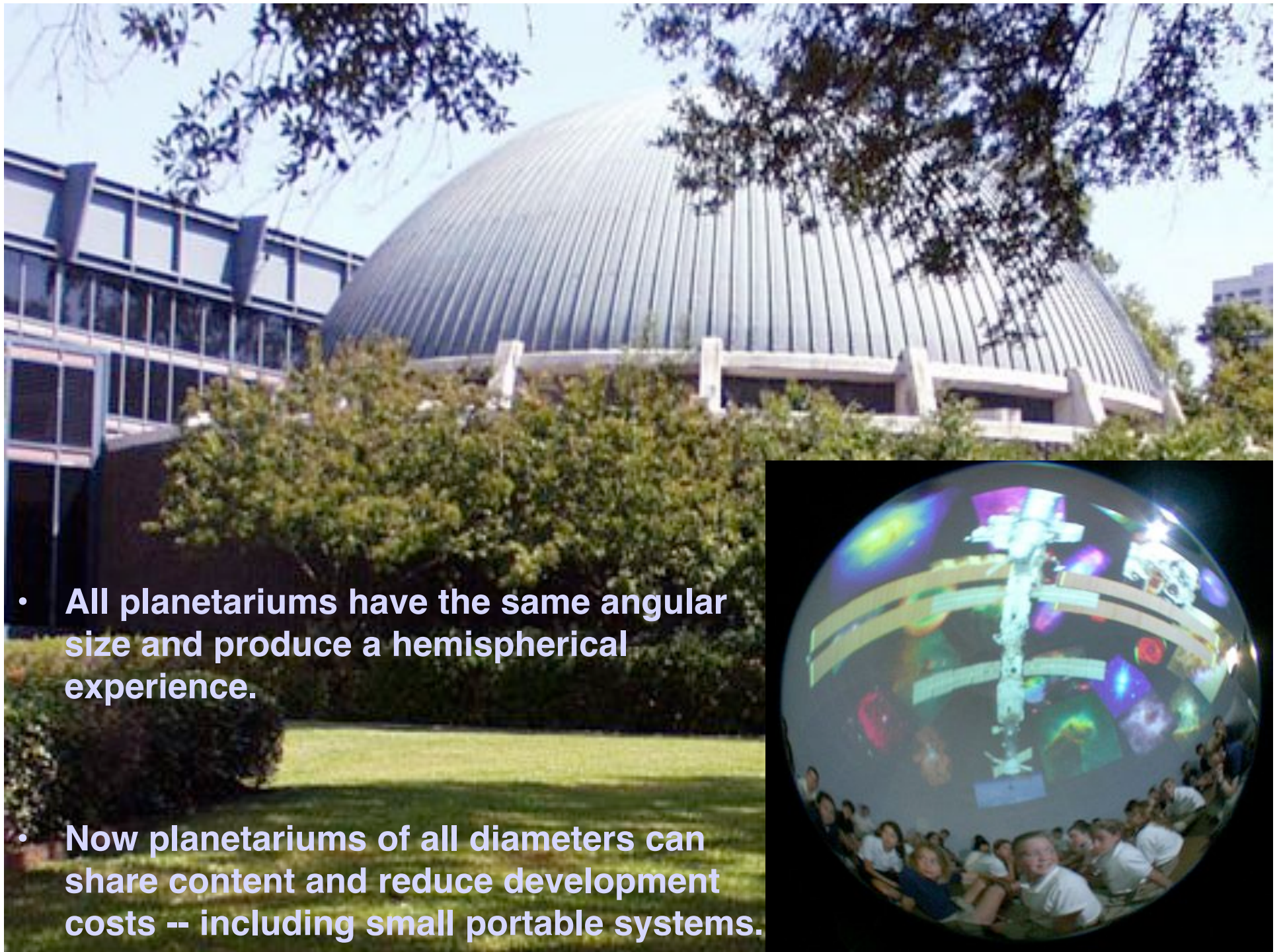
Carolyn Sumners
Houston Museum of Natural Science

Pat Reiff
Rice University

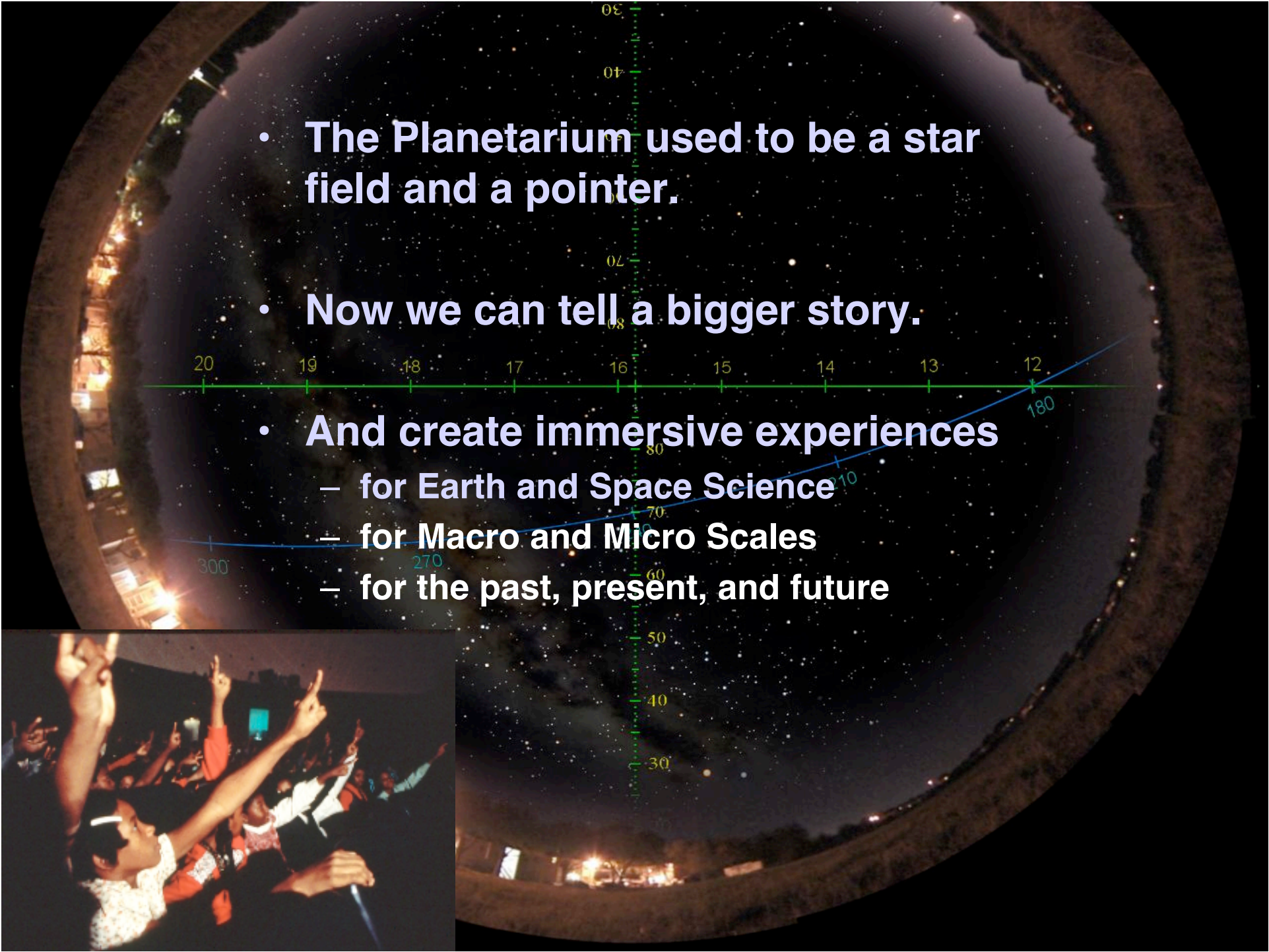


New technology brings immersive experiences to the student, surrounding him or her in an interactive virtual environment, often beyond direct observation. In this dome CAVE, students can make discoveries as they are made in science visualization laboratories. In like manner, visualizations developed for scientific research can be adapted to create student learning experiences.

Modern science takes place in environments and at time scales beyond direct human observation. An urban classroom on Earth is not the best place to observe interactions ranging in scale from solar system bodies to the components of a cell. Often learners are forced to create their own mental images to understand situations they cannot view directly. In many instances the result has been a misconception that takes on a reality of its own inside the student's mind.



- All planetariums have the same angular size and produce a hemispherical experience.
- Now planetariums of all diameters can share content and reduce development costs -- including small portable systems.

- 
- The Planetarium used to be a star field and a pointer.
 - Now we can tell a bigger story.
 - And create immersive experiences
 - for Earth and Space Science
 - for Macro and Micro Scales
 - for the past, present, and future



- Consider our options ----

- To travel through time

- Cretaceous Dinosaurs
 - Big Bang
 - Colonization of the Moon

- To travel through history

- Stonehenge
 - Galileo's Study
 - Bridge of the Titanic

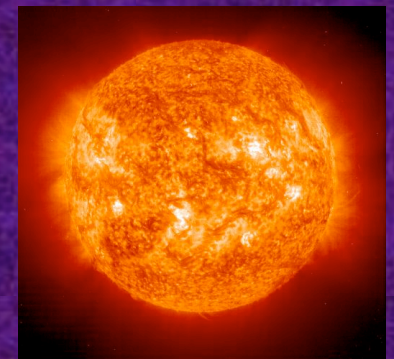
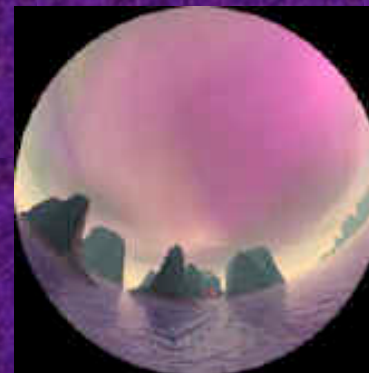
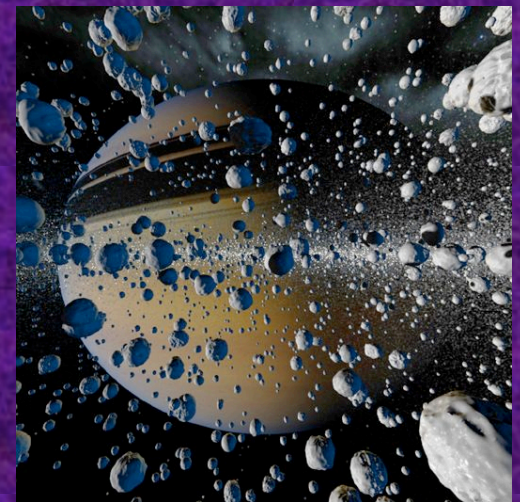
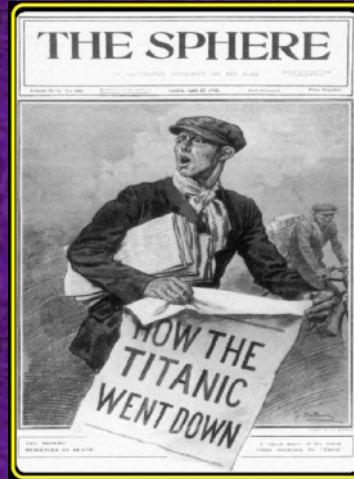
- To travel to distant places

- Orion Nebula
 - Supernova
 - Mars or Saturn

- To visit dangerous places

- Hurricane
 - Tornado
 - Coronal Mass Ejection

- To change reference frames -- Making a question requiring a change of reference frame into a concrete operation



It's Great to Have a Great Story NIGHT OF THE TITANIC

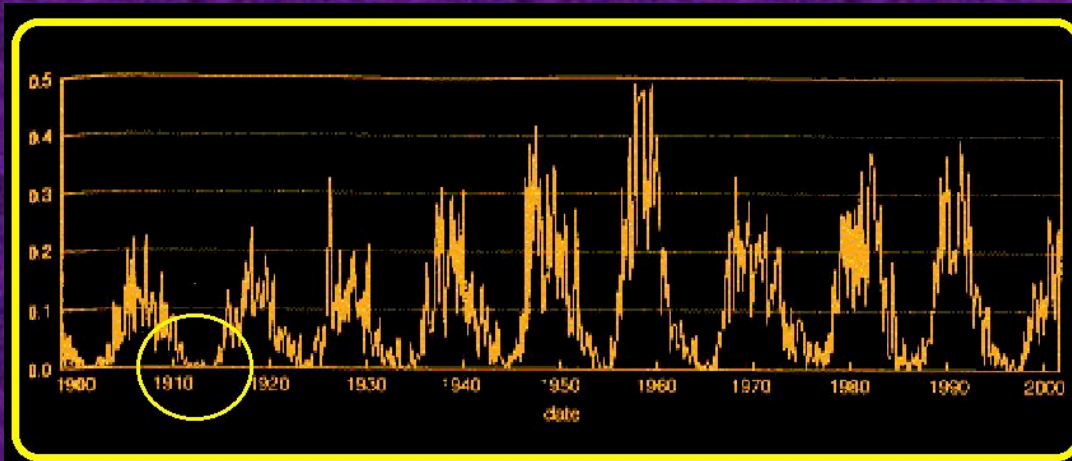
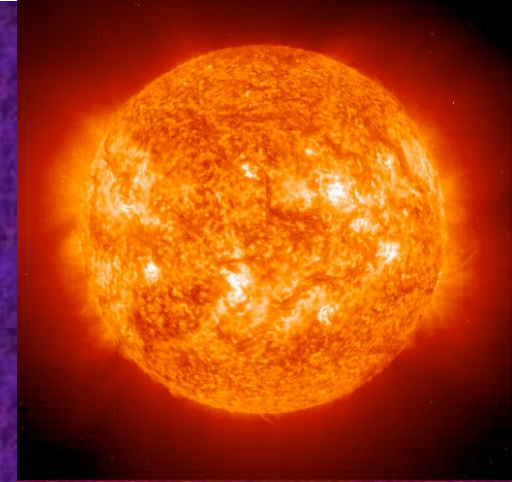
The Science that could have saved the ship!



- What happened on Apr. 14, 1912
- Let's go to the deck and find out!



Night of the Titanic



- Spring is the season for icebergs - especially April.
- Solar activity was at a minimum in the sunspot cycle.
- The sun was fainter than now in 1912.
- 1912 was the coldest year of the century in $20^{\circ} - 50^{\circ}$ N.
- April 1912 had more sea ice off the coast of Newfoundland than any other April of the century.

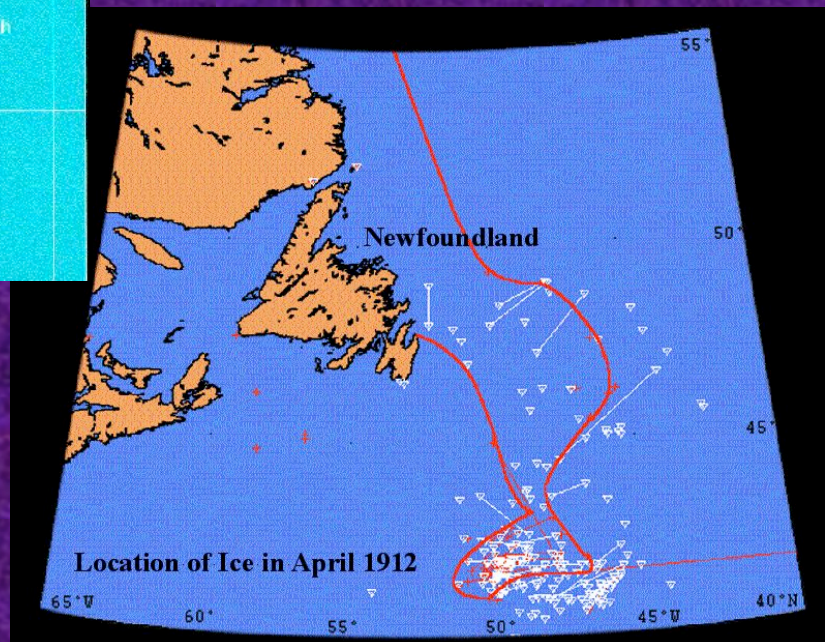
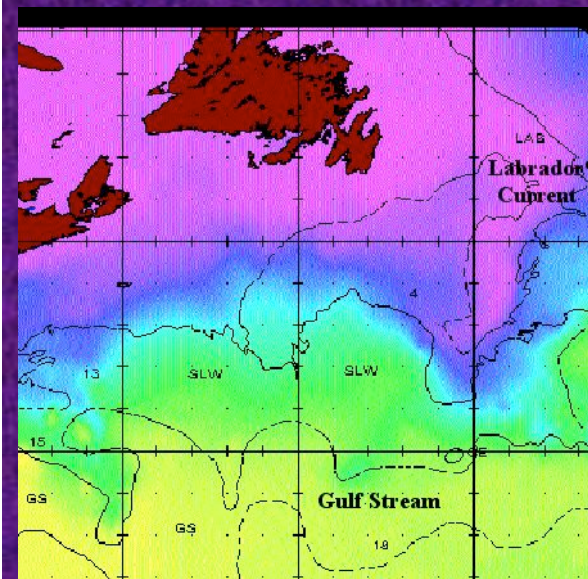
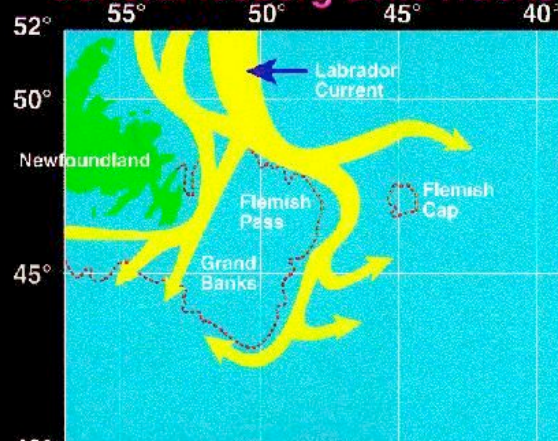


Night of the Titanic

Where icebergs calve
Grand Banks drift tracks
Labrador Current meets
Gulf Stream
Location of Ice in April
1912



General Iceberg Drift Tracks



Night of the Titanic



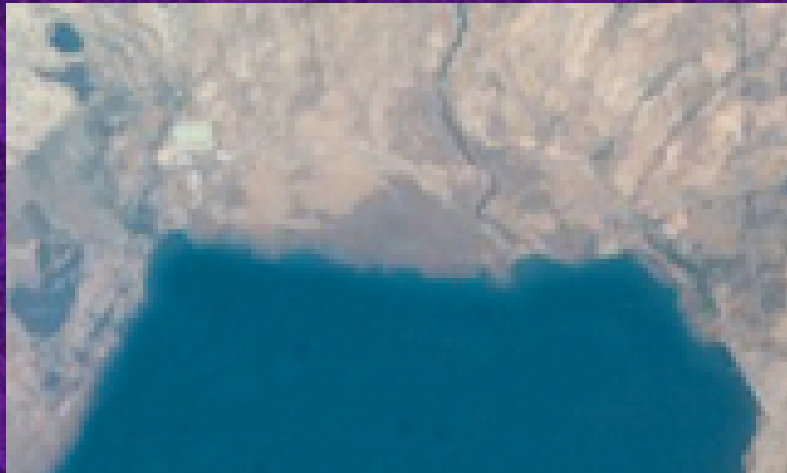
How
did
the
ship
really
sink?

Secrets of the Dead Sea

- To show the changes in the Dead Sea

1968 (Apollo) on left

2002 (ISS) on right



Secrets of the Dead Sea



- To see the global picture

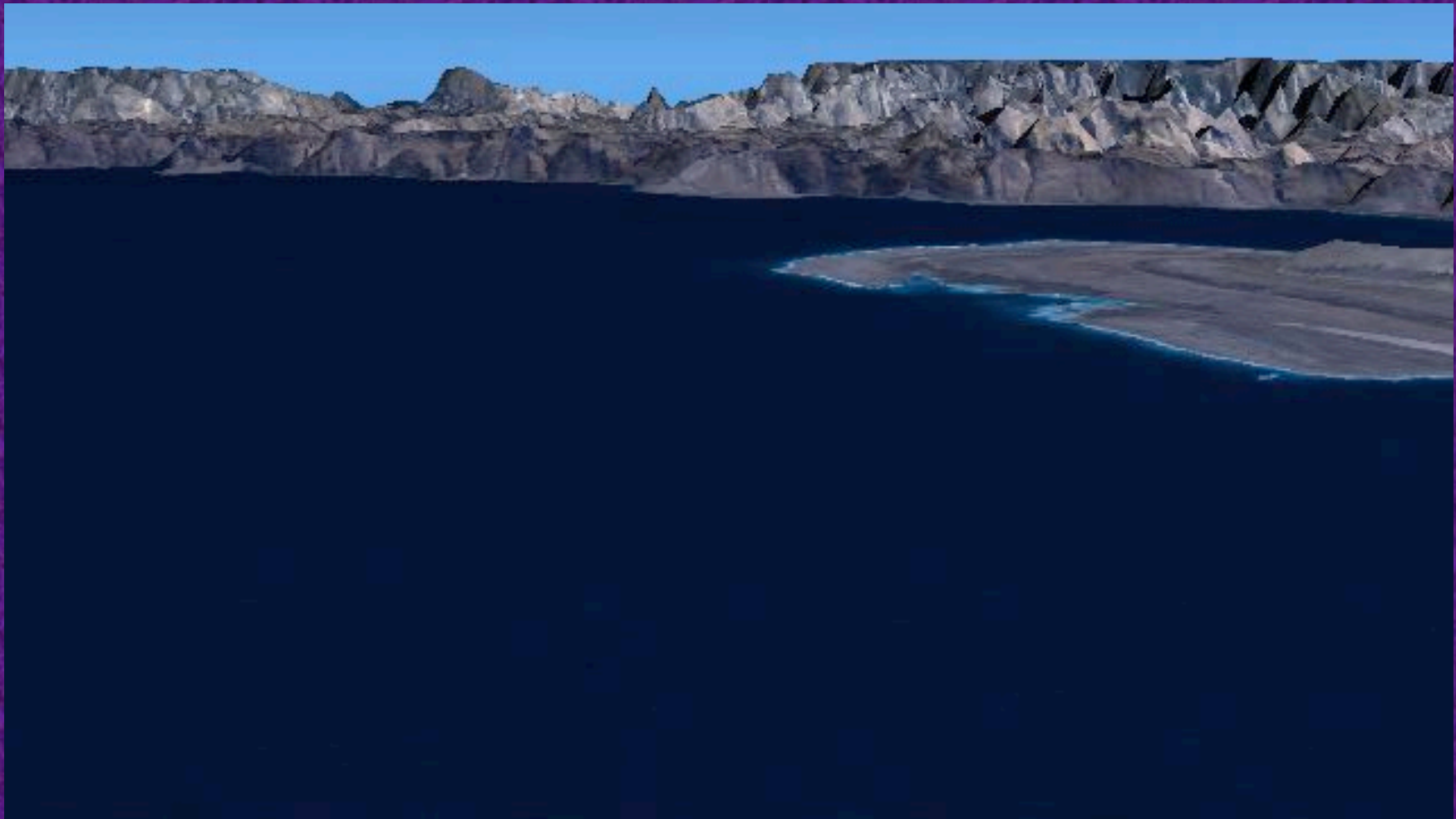
Rift Valley

Land Usage



Secrets of the Dead Sea

- To fly along the rift valley with NASA altitude data and change the level of the Dead Sea



Secrets of the Dead Sea

- To use a large format fisheye lens camera (14megapixel -- 3,000 pixel wide fisheye image) to take audiences to places around the world.



Left: Dead Sea at Masada



Lower Left: Dead Sea shore



Upper Right: Grave of Ilan Ramon



Lower Right: Treasury at Petra

Earth Science

- Force 5:
- The Ultimate Storms

- » Hurricanes
- » Coronal Mass Ejections
- » Tornadoes



Earth's Wild Ride

Immersive Earth Product

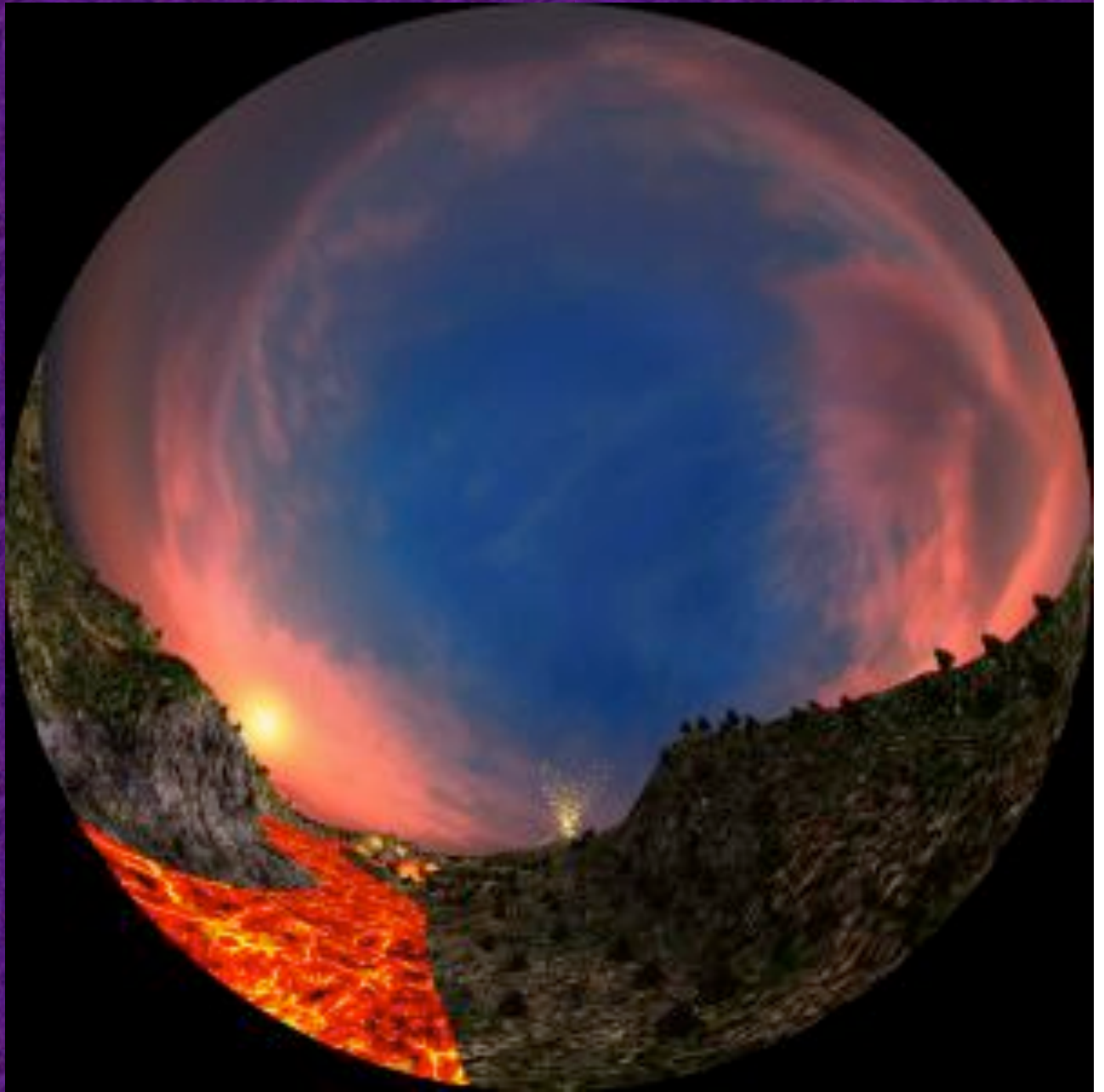
- To teach the Earth's interrelated spheres: atmosphere biosphere, geosphere, hydrosphere, and cryosphere.
- To see Earth's global systems through the eyes of children born on the moon.
- To tell a story - passed from grandfather to grandchild, just as stories have been passed from generation to generation throughout human history.



Earth's Wild Ride

Children see
smoke above
Sicily and ask
about it.

Grandfather
tells story of
volcanoes on
Earth, but not
on the moon.



Biosphere

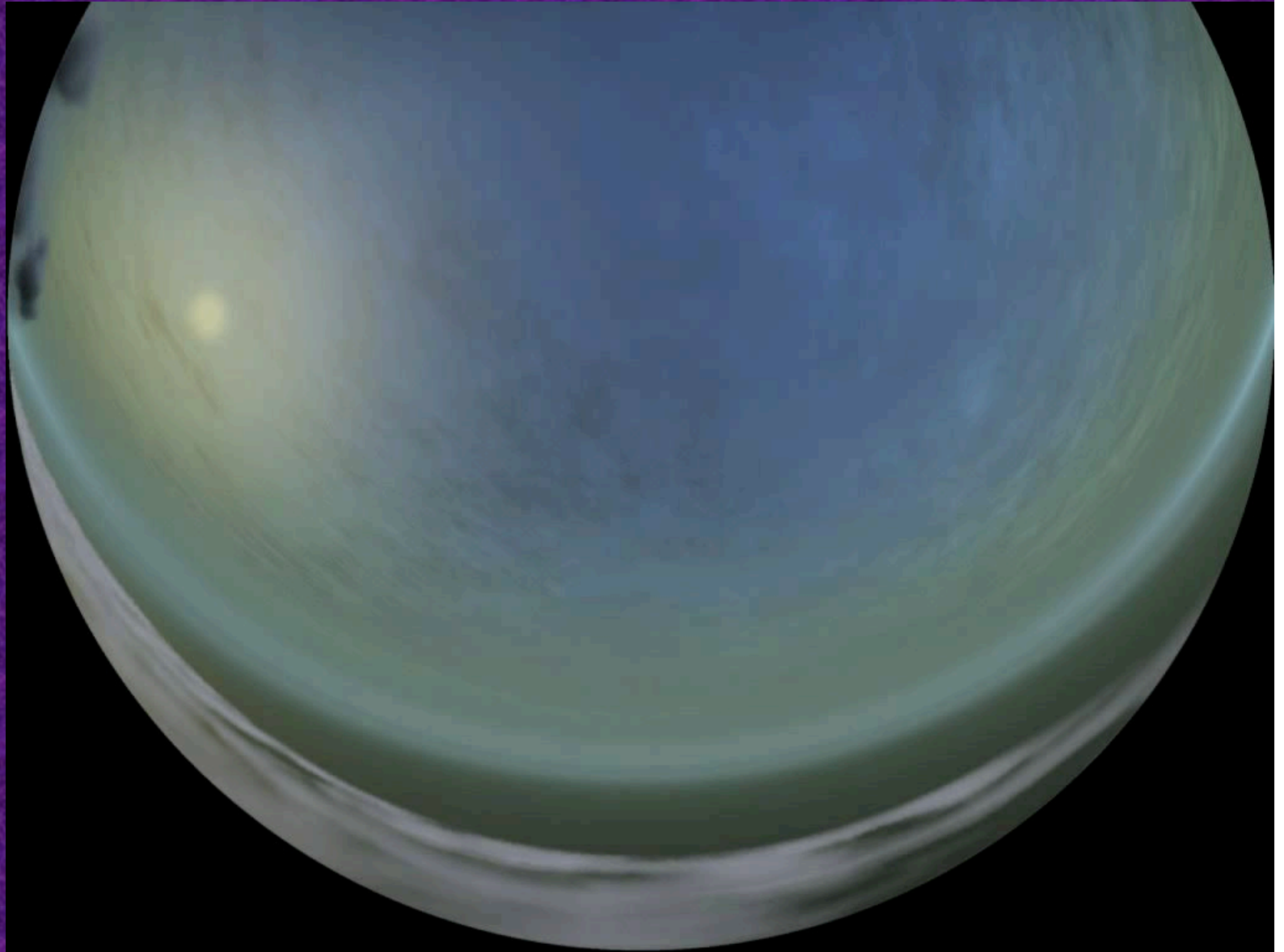
Kids realize that moon craters are made by impacts and ask about impact craters on the Earth.

Grandfather tells the story of a very big asteroid that hit Earth 65 million years ago.



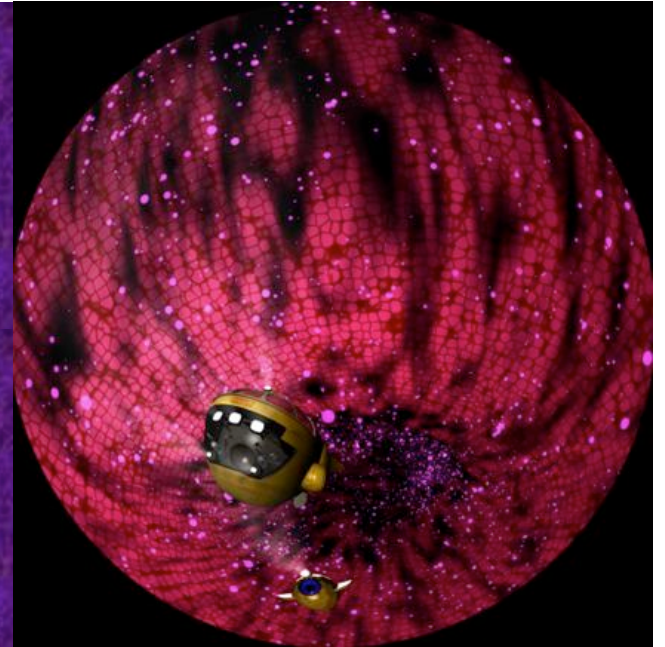
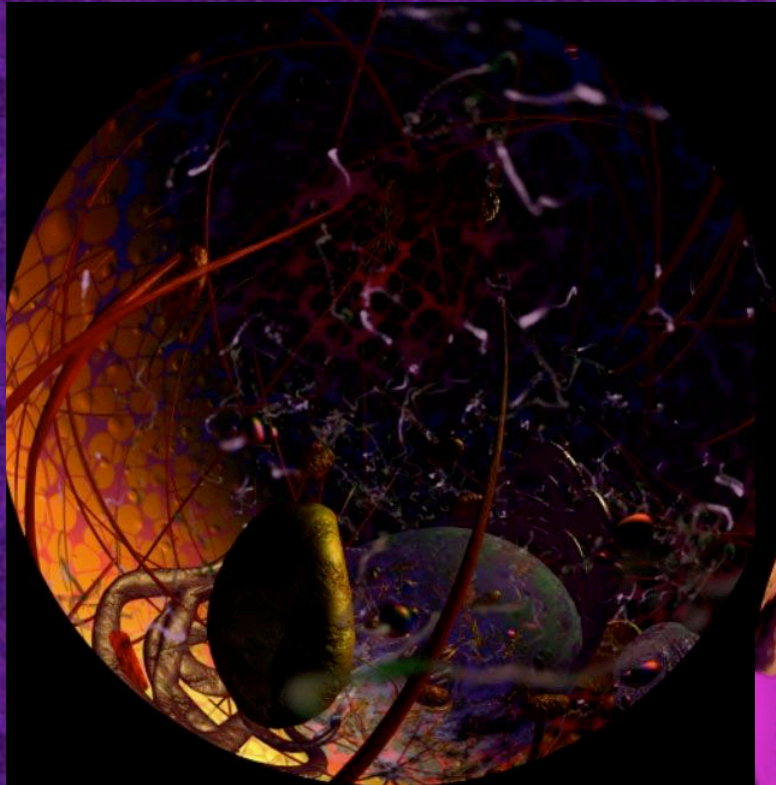
Atmosphere & Hydrosphere

Children
born on
the
moon
have
never
seen
clouds,
felt rain,
or
floated
on a
river.



Microcosm: Virtual Voyage Through the Human Body

With “gold nanoshells”, we can imagine traveling through the human body at a scale equivalent to the distance to the Moon.



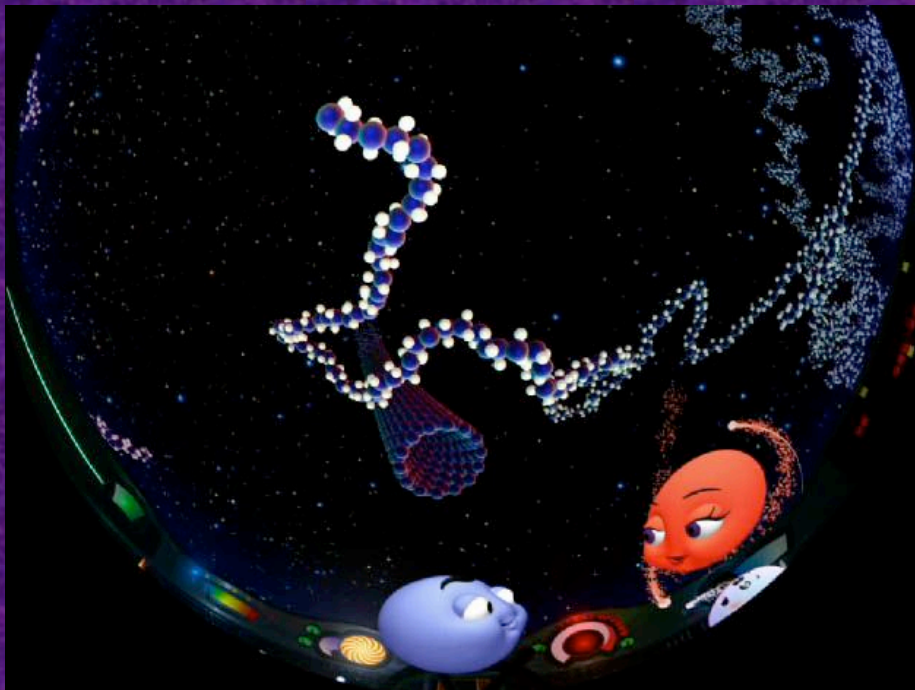
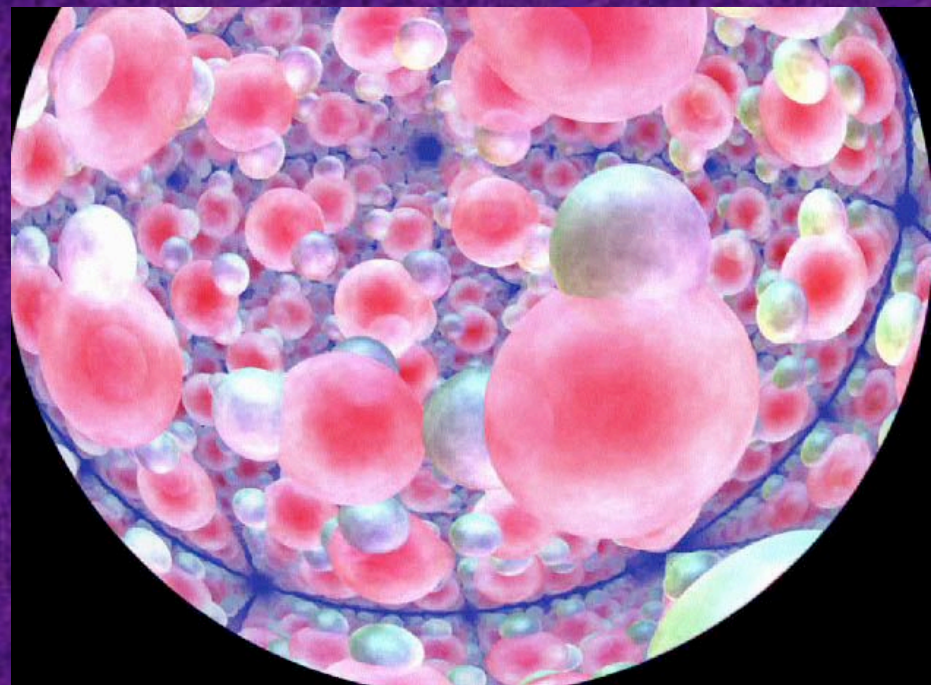
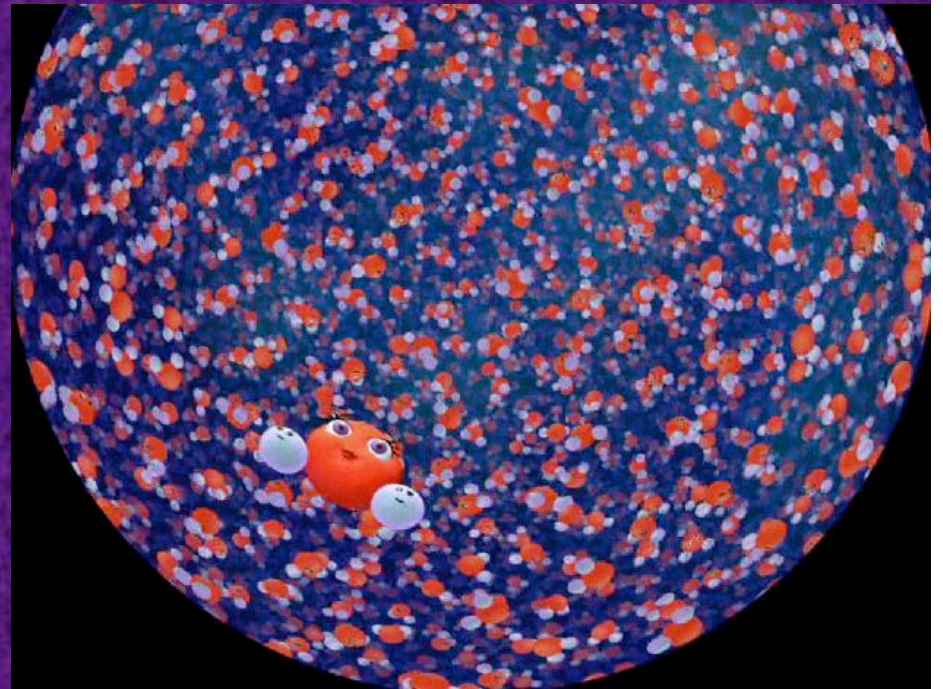
Carotid artery - above right
Cell - above
DNA in nucleus - right
(developed with Evans & Sutherland)

Moleculararium: Join “Oxi” on a trip through molecules

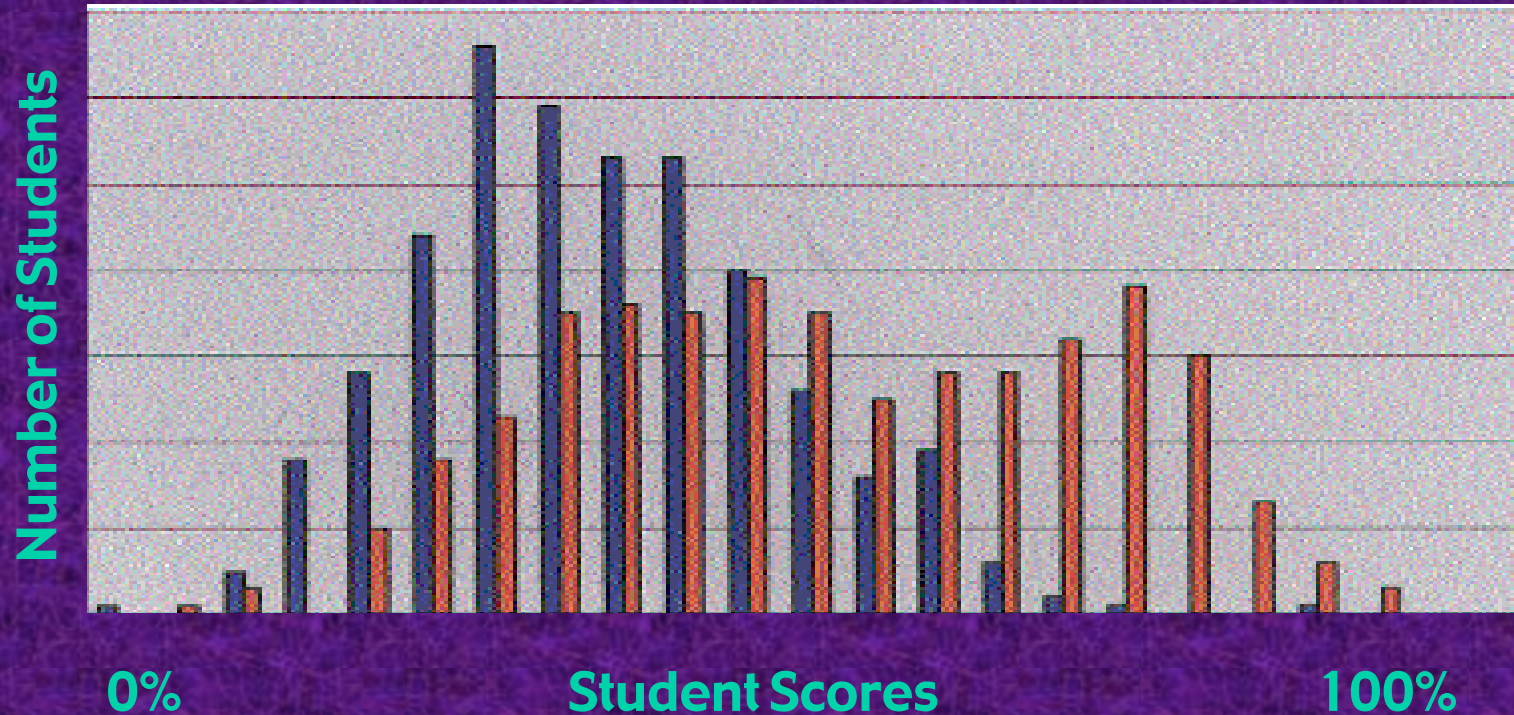
“Oxi” with “Hydro” and “Hydra”
in a water drop - right

Water molecules in a snowflake
- lower right

Carbon in DNA and Nanotube - below
(produced by RPI)



**Immersion Experiences
teach complex concepts better than
words, single images, or standard video.**



**Good students, poor students,
students who like science and those who don't
and students with limited English proficiency
can all gain from full dome lessons.**

Immersive Earth Partners



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LASM
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IRENE W. PENNINGTON PLANETARIUM

BE DAZZLED.

Irene W. Pennington Planetarium
EXXONMOBIL SPACE THEATER



You will be mesmerized by Baton Rouge's star attraction—The **Irene W. Pennington Planetarium**. The giant 60-foot dome theater is one of the most sophisticated multimedia presentation theaters in the country—presenting planetarium programs, large-format films and high-resolution video projections in the **ExxonMobil Space Theater**.

The **ExxonMobil Theater** not only dazzles with 15,000 stars, it's also home to Baton Rouge's only 70mm, 9-perf projection system. Presentations feature thrilling, larger-than-life films capable of convincing you that you're really aboard a Space Shuttle lift-off, navigating the celestial labyrinth of outer space or discovering the wonders of the West.

The planetarium also offers 5,000 square feet of out-of-this-world exhibits, where you can weigh yourself on the moon, meet Galileo, and even touch a falling star—a meteorite a billion years older than any earth rock.

Visit LASM's newest star, the Irene W. Pennington Planetarium today—and come back often. Your entire family will be dazzled by the wonders of the solar system and the universe beyond.

Sunday October 5, 2003 4:56 PM

INFINITY EXPRESS

...the universe is slowly offering up its secrets



The LodeStar Astronomy Center is located in the

**NEW MEXICO MUSEUM
OF NATURAL HISTORY
AND SCIENCE**

1801 Mountain Rd. NW
Albuquerque, NM 87104

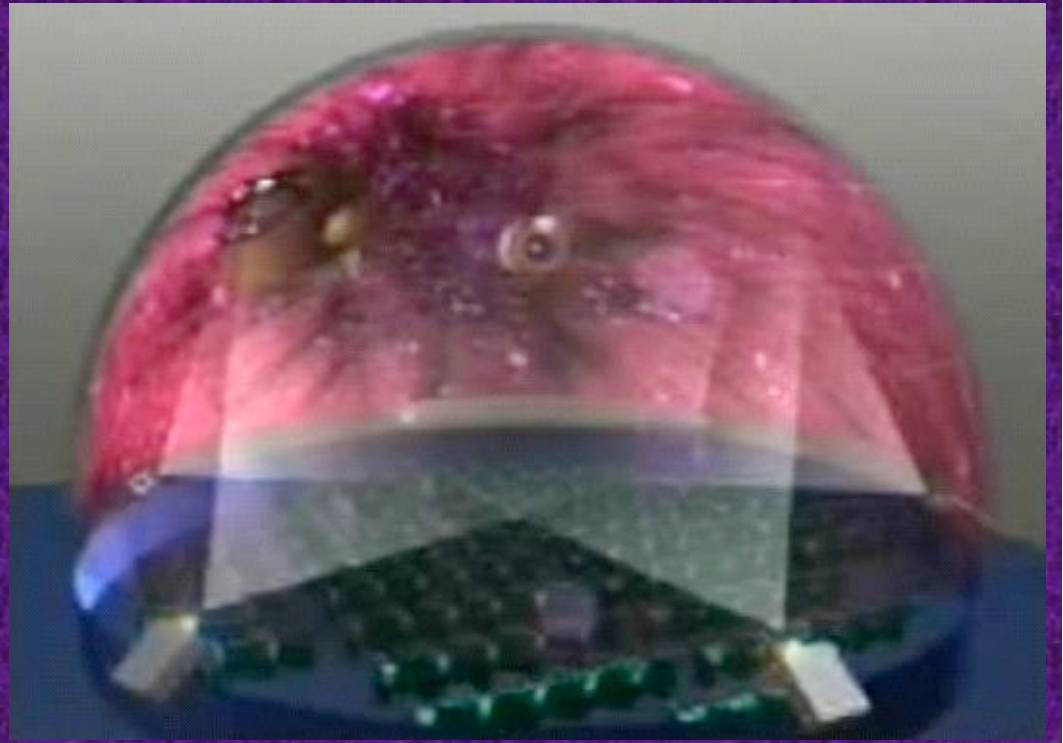
Portable Discovery Dome

- Biggest experiences in smallest dome
- Immersion: Taking kids where they have never been and can never go!
- 7,000 visitors in the first pilot year.
- Booked by schools, PTOs, scout fairs, astronomy days, etc.
- Used for promotions at city events including the Opera and Symphony



Projection Technology

- The medium is the dome master -- fisheye lens projection of a hemispherical scene
- Stored as sequential files to be played at 30 fps -- minimum resolution: 2200 pixels in diameter
- Playback file reduced to a 1024 X 768 mpg for the small portable system (1400 X1050 for higher res).
- Big planetariums use six or more projectors and computers slicing up the fisheye image to get enough pixels on the dome.

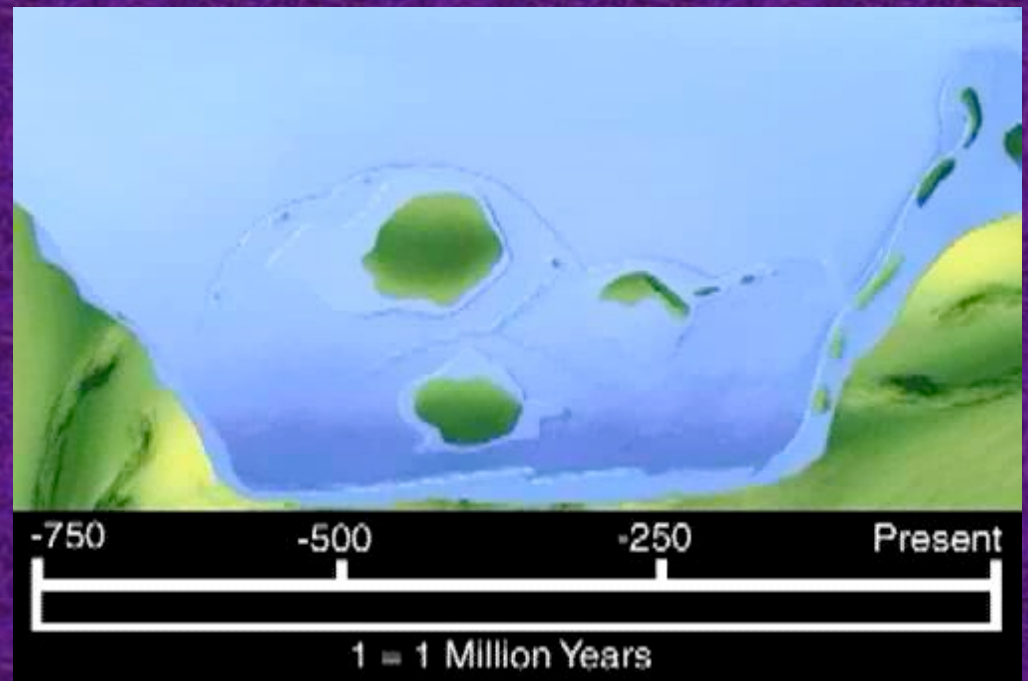


- The Portable System includes fisheye lens projector, Shuttle PC computer, small monitor, dome, and fan.



Future Projects

- The Extremes of Earth Life:
 - **Fantasy Worlds: Exploring the Limits of Life**
 - Where life is on Earth
 - Where life may be in Space
- Global Climate Change:
 - **Disappearing Dinosaur Mysteries**
 - CSI format
 - What killed the dinosaurs (from late Triassic to Cretaceous)
 - Analogies to future of current dominant species!
- Change Through Time:
 - **The Sahara: What Lies Beneath?**



Global Climate Change

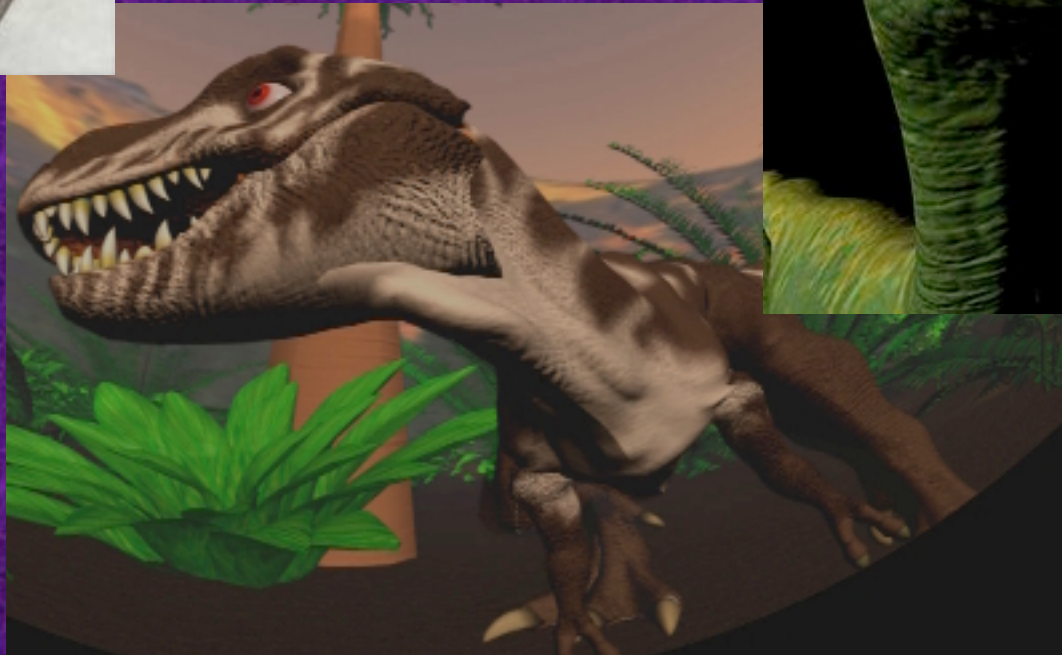
Late Triassic - Ghost Ranch **flood** - Coelophysis

Mid-Jurassic - Utah - **Vegetation Change** - Allosaurus, Diplodocus

Late Jurassic - Liaoning, China - **Volcanic Eruption** - Sinornithosaurus

Late Cretaceous - Hell Creek - **asteroid impact** - T-Rex, Triceratops

The T-Rex is closer in time to humans than to the Coelophysis



What we Need

Contact us if you have models,
data-based stories, or need for an
outreach program.

What we're looking for right now:

- Plate Tectonic animations with vegetation
- Models of satellites that monitor flooding
- Models of satellites that monitor vegetation
- Models of satellites that monitor volcanic activity
- High resolution imagery from these satellites



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